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EVOLUTION AND CREATION

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EVOLUTION AND CREATION
TALKS ABOUT RADIO
ETHER AND REALITY
MAKING OF MAN
MAN AND THE UNIVERSE
RAYMOND: OR LIFE AND DEATH
THE SURVIVAL OF MAN
REASON AND BELIEF
CHRISTOPHER
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New York: George H. Doran Company

EVOLUTION AND CREATION

BY

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TO MY SYMPATHETIC FRIEND AND
KINDLY NEIGHBOUR
VISCOUNTESS GREY OF FALLODON
THIS BOOK IS INSCRIBED
BY THE AUTHOR

PREFACE

"CREATION" signifies the process by which all observed things—what we call natural phenomena—have come into being; and it is a process which in many of its aspects mankind has become able to follow in some detail. We find that it is conducted, in a spirit of law and order, by a gradual process of evolution—a process of becoming or unfolding. The details of the process we, with our limitations, have to subdivide and study under different heads: no one man can fully grasp them in every branch. Fortunately there is a recent book which tries to describe what is known about evolution in different branches of knowledge—Cosmogony, Geology, Zoology, Botany, Physiology, Anthropology, Psychology, Physics, Chemistry, etc.—by Authorities in these comprehensive subdivisions, who collectively seek to expound what Science at present has to say on the subject, under the

general title *Evolution in the Light of Modern Knowledge*. The present book assumes the general truth of the facts and laws of nature as now known, and looks at the matter from a more general standpoint, seeking to reconcile the scientific and the religious or theological points of view: for these diverse aspects need no longer be regarded as hostile or opposed to each other, but rather as different facets of one and the same general truth. No one, I hope, will suppose that all scientific men agree with all I say on religious topics; differences of opinion are inevitable about such subjects as free will and Theology. I express my own strongly-held opinion, for whatever it may be worth.

Note.—Some of the following chapters embody the general sense of a Huxley Lecture delivered by me at Charing Cross Hospital on the third of December, 1925; and likewise some midday talks on Evolution at Christ Church Westminster in the same month. The general idea represented in the Conclusion to Chapter VIII, about the main drift of the Bible as a whole, is mainly due to my artist son, O. W. F. L., though I am responsible for adopting it.

OLIVER J. LODGE.

1st January, 1926.

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PROLOGUE

Evolution and Creation

PROLOGUE

MY THESIS is that there is no essential opposition between Creation and Evolution. One is the method of the other. They are not two processes, they are one,—a gradual one which can be partially and reverently followed by the human mind. We have the right to study the methods so far as we can, the right to probe into the manner by which the manifold things around us are interrelated, and how they have come into their present form. We try to set forth the physical processes in detail, and for that special purpose to limit ourselves to the mechanical, the physical, the chemical, the calculable, and the directly observed; without the least trace of impiety, and without being reasonably accused of denying a great tract of country which is not on our beat, which we are not exploring, and which,

though through lack of time and energy we perforce neglect, we do not (if we are wise) ever think of denying.

Regarded only from the physical point of view, the Majesty of existence is overwhelming. To me Creation seems to be an eternal process, always going on; we see the process occurring before our eyes, before our mental eyes: the history of this planet is but an episode in the cosmic scheme. Recent discoveries are amazing. Do not think that the great Philosophers are dead. They are Physicists now, Physicists and Astronomers of the first magnitude. Philosophers are learning Physics as never before, and a new Philosophy is being born, based on more information than was accessible to the Ancients, or even to those of the last century.

So far from excluding God and the Spiritual world, our present outlook—in moments of insight—leaves room for little else. We are impressed with the constant activity of some beneficent Power. There are always parts of the Universe without form and void, always the brooding Spirit is bringing cosmos

out of chaos, fresh worlds are coming into being, old worlds are proceeding towards decay. And yet, maybe, towards no final end: so far as we know, the process is eternal. We cannot yet be sure of recuperation, restoration of energy, re-formation of matter, but there are hints. Meantime we can watch the operations at work; we can study the details. The grandeur of the scale, the vast tracts of time, are almost too vast for human intelligence. And yet not too vast for us to apprehend and follow them in their outward appearance, provided we allow ourselves to think in terms of time, and to treat as a sequence what is really a co-existence.

Everything flows, nothing is stagnant, said Heracleitus,—and it is profoundly true. The constant activity of the molecules all round us is amazing when we realise it, and the evolutionary changes which result therefrom have led us to postulate,

First an ether full of intrinsic circulation,

Then the knotting of parts or specks of it into electric charges,

Next the falling together of these charges so as to constitute atoms of matter.

Then the agglomeration of matter into great clouds endowed with rotation,

Then the gradual increase of rotating speed, till the masses emit streamers, which break up into great stars of varying high temperature; the radiation loss from which makes them shrink into compacter stars, from whence come planets, on which are born the germs of life.

Then the stars, still radiating their energy, and losing substance, shrink and darken and perhaps ultimately disappear, leaving once more Ether and Radiation, so that the whole process can conceivably begin again.

A process in time, we think it; but we see it in all stages, and the stages are concurrent. Is it not a cyclical process going round and round?—a loom from which emanates a gradual rise in spiritual values and all the hopes and aspirations of countless conscious beings, among whom we are by no means chief. These spiritual developments are surely not recurrent, they progress from strength to strength,

they utilise the physical process for real growth, real progress, real evolution. These are the things which shall endure, and for which all else exists.

Chapter I: On Evolution in General

CHAPTER I

ON EVOLUTION IN GENERAL

THE word "evolution" is often employed as an antithesis or opposition idea to creation: and it is quite possible that when Herbert Spencer was trying to extend ideas derived from Darwin, as to the natural processes by which Species had originated, and to apply them to the production of everything, some notion of that kind was in his mind. He probably felt that he was exploding the popular idea of a sudden creation, a production of things by a creative Fiat, and substituting a long, slow and gradual physical or atomic process, through which the simple evolved into the complex, and the potentialities latent in the atoms of matter become unfolded, developed, evolved; as a bud unfolds into a flower. Thus a personal activity, guided by something like will and intention, seems

replaced by an automatic and so to speak mechanical operation among the things themselves. It is curious that the discovery and investigation of mechanism should seem to exclude the idea of purpose, intention, planning. No machinery of our own construction, however automatic in its working, gives any but the most superficial suggestion of absence of mind or purpose. Still that was the idea, a fortuitous mindless mechanical Universe; with living creatures able to reproduce themselves without limit, unaided, self-confident, complete. "During such time as we have evidence of, no intelligence or volition has been concerned in events happening within the range of the solar system except that of animals living on the planets." And again—another summary, also by that brilliant enthusiast, W. K. Clifford—"The world is made of atoms and ether, and there is no room in it for ghosts."

How animal mind and human consciousness could arise and enter into such a scheme was hardly known, though there were and had been guesses about that too, and the doctrines called

Parallelism and Epiphenomenalism were sustained by different philosophic writers. Indeed how life, even of the lower organisms, originated, was never answered: and though many attempts were made all over the world, and for centuries, at spontaneous generation, —some of them in late years by Charlton Bastian at King's College, London,—they never succeeded in producing life except by faulty experimentation. So it was gradually established, and accepted by Huxley, that life only proceeded from antecedent life, so far as our experience went: that if all vital germs were excluded, no life, even of the lowest kind, appeared. It was research on these lines which summoned the great Pasteur from Chemistry to Biology. It laid the foundation for his theory of disease, and it was the noble work of Lister to apply it with beneficent results to surgery. Thus and by all these channels was emphasised the doctrine of Biogenesis: that life alone could produce life.—Life produced itself, however, in its various forms, by a process of evolution, and by no act of special creation. The vital steps were gradual and could

all be followed, once given the germ of life. The origin of life itself was left as an insoluble mystery, or rather as a mystery to be solved by science at some future date. And it was thought, at any rate by some, that once life made its appearance in the scheme, the evolution of mind was only a further step in the process: Mind was apparently a stage ahead, to which life might aspire,—life in the course of ages might blossom into mind.

The attempt thus to explain evolution as a gradual self-acting process was a legitimate one, and contained (as we now see) many of the elements of truth. It led to a materialistic philosophy, which for a time held the field, and attracted the attention and the enthusiasm of a multitude of workers. It was however not the whole truth: it was a well-founded working hypothesis. It went a certain distance with success, and only gradually were its weaknesses perceived. It was not so much wrong as incomplete. As far as it went it was right, and as an intermediate step was helpful and stimulating. The idea that vital processes were purely chemical and physical, that the

organism was explicable on mechanical principles, and that no unknown or mysterious principle was involved, invigorated the science of Biology with a working hypothesis which has proved of great service; it served as a clue or guiding light among a multiplicity of phenomena which without it had seemed detached and disconnected: and it stimulated observation and experiment to a remarkable degree. On its positive side it was full of truth and value; only in its negations was it weak. It carried workers a long way, and it carried enthusiasts too far. It seemed to lead to the exclusion of mind and purpose from the Universe, and aimed at replacing them by mechanism. It was a scientific clue or theory, not a complete philosophy. If a materialistic philosophy had worked, it would have been justified by results. But it was incomplete; and gradually its weaknesses and omissions became apparent; so that by this time, as a complete account of the Universe, it is recognised as insufficient and faulty. The mistake—if it can be called a mistake—lay in the thoughts or contentions of those who put evolution forward as

in opposition to the idea of creation, instead of regarding it as a method of creation, and who denied the existence of any plan or purpose.

The old idea of creation, as a sudden achievement without intermediate steps, without any process that could be followed by the human mind, and without any extensive lapse of time, was seen to be erroneous. And yet, amid much crudity, most of us now perceive that it contains some elements of truth: just as the working hypothesis of mechanical evolution did. The time was not yet ripe for identifying and unifying the two. They seemed to be in the field as opposition theories one against the other. They seemed to be mutually exclusive; so that if one were accepted, the other must be rejected.

Whether this opposition of the two views was seriously in the mind of the philosophers of that period may perhaps be questioned: in all probability it sometimes was. Among the rank and file it certainly was: many half-educated people leapt to the conclusion that the Universe could be fully explained on mechanical principles and in terms of matter, and

that in matter could be found the full potentiality of life and mind and everything that we have so far discovered or experienced in the Universe,—the promise and potency of all forms of life, as Tyndall said. Whether or not that was the intention of the leaders may well be doubted. Huxley himself made it abundantly clear that in his view a materialistic philosophy had its limits, and that consciousness could not thus be accounted for. Nevertheless the two views, in the popular mind, were in opposition; and it led to alarm among the Churches at the doctrines of Darwinism and at the teachings of evolution generally. And this feeling of antagonism between the two views, coupled with instinctive alarm and dislike of one of them, has survived in certain States of America, and has led to an attempt to suppress the disliked view by legal enactment.

However irrational this procedure may be, there is some excuse for it: and it is possible to regard their conscientious action with sympathy, even though the sympathy is mingled with amusement. Not in that way is truth

really served. Freedom is the life-blood of science; and freedom is only consistent with the power of making mistakes and going wrong, as well as with the power of ascertaining truth and going right.

Crudities were not confined to one side of the controversy. Old doctrines of creation were crude; new doctrines of evolution were equally crude: and either side could have their teeth set on edge by the other. Young and enthusiastic teachers, perceiving only one side of the problem, could rush into extremes; could not only uphold their own view, but could pour scorn upon the other. And since the sectarian differences between religious bodies had led to the suppression of what may be called Biblical teaching in State schools, as the only alternative to strife and sectarian controversy,—since the freedom of the orthodox was limited and they were prevented from teaching the young their own special and detailed creeds,—it became obnoxious to allow perfect freedom to the opposition side, who took no interest in sectarian controversy but would gladly sweep away the whole of the doctrines associated in

the popular mind with the mysteries of Religion. Sectarian differences had limited freedom on the one side: it seemed right to limit freedom on the other too. And that I take it is the explanation of what otherwise seems an irrational and foolish procedure.

There are I know a multitude of people in this country who still feel the fundamental opposition between the two views, and some who in their heart sympathise with the action of those Southern States who have put the law in operation against one of them. There is always some justification for any human action which is well intentioned and sincere, however mistaken it may be. We are all of us constantly making mistakes: the proverb says "It is human to err." And it is part of our training to be able to make mistakes with perfectly good intentions; one of the mistakes being to think that we have an infallible guide when we have not. Infallibility has not been granted to man. We have to make our way among pitfalls and obstacles, to make progress slowly and with difficulty, and gradually to learn what is true by finding out what is false: never

learning the whole truth (for that we could not apprehend), but making our way towards the truth, in a blundering but persevering manner.

The very documents to which some of the ultra-orthodox pin their faith are full of misstatements and errors committed by humanity in the past; and however full they are of inspiration (as in many parts I am sure they are, much more, as I think, than some educated people are always inclined to admit), yet they are human documents, full likewise of the mistakes, misinterpretations, slips and errors, appropriate to the human vehicles through which they have come. It is our business to try and sift the true from the false, the genuine from the mistaken, the misinterpretations of scribes, the faulty reports of occurrences, and thus to dig down to the underlying essence, which gives these documents their supreme value.

The book of Inspiration, by which I mean the thoughts of the great thinkers and seers and saints and prophets of all time, is one avenue of truth: the book of Nature, explored

by a multitude of energetic workers, that is to say the book of science, is another. In so far as both are true, they cannot be in opposition. In so far as either is mistaken, opposition is inevitable: and although the virulence of the opposition is now greatly mitigated, and is not fierce and uncompromising, as it was even in the lifetime of some of us, some amount of opposition exists still. Indeed in the minds of half-educated people its virulence is still manifest, and some fierceness of opposition still subsists to this day. It is so easy to take one side only of a controversy, to regard that as completely right, and the other hopelessly and completely wrong. We find this attitude even in party politics. We find it more or less in the forensic activities of Counsel in the law courts. It is understood, there, as a method of laying the case before the judge, to whom is left the impartiality of scrutinising the evidence for what it is worth, and coming to a judicial and balanced decision.

But we ourselves, in our own minds and with our own responsibility, are both counsel and judge. There are moods in which we empha-

sise one side; there are moods in which we emphasise the other: but ultimately we try to hold a balance between them, and we doubtless hope that our ultimate convictions will be based on the evidence, and will lead to a true and impartial verdict.

Chapter II: On Creation or Origins

CHAPTER II

ON CREATION OR ORIGINS

NOW let us read the poetic account of the genesis of the material Universe in our ancient Book.

In the beginning God created the heaven and the earth.

And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God brooded over the chaos.

And God said, Let there be light: and there was light.

I must assume that I am not addressing what may be called "the left wing," namely those who pride themselves on being what they call "Free Thinkers," who imagine that they have emancipated themselves from any vestige of superstition, and who are willing to throw over the inspiration of the past as mere imagination, and to build upon the perceptions of

the mechanical and material present; who are satisfied with the evidence of the senses, and who conclude that they understand the Universe in its general outline in a complete and satisfactory manner.

On the other hand, I hardly expect that I shall be addressing many of what may be called the ultra-orthodox, those who are sometimes spoken of rudely as Bibliolaters, or more politely though more vaguely as Fundamentalists: that is to say, those who think that they have in the Scriptures of the Old and New Testaments an infallible guide given to humanity by the Deity, without flaw or error, every word of which must be taken as exact truth, and against which there is no appeal, either on the ground of scientific investigation, or common experience, or the enlightened conscience, or any other subterfuge of ambitious man.

I am probably speaking mainly to those who have reverence for these writings, and are willing to learn from them, who have a respect for scientific enquiry, and are willing to learn from that; knowing that neither is infallible, and that ultimately there must be reconciliation

between the elements of truth in both. And if to you therefore I can be of any service, it will be by trying to exhibit the elements of truth which have appealed to me in the course of a life devoted to scientific research, and has not been entirely aloof from attention to the Documents as well.

The amount of ground that might be covered is immense. If one attempted to enter on a consideration of the doctrines associated with Christianity, one would be involved in speculation and in a region of fact not yet accepted by or incorporated into science; I mean the so-called "psychical" enquiries in which also I have been engaged, and which in their tendency are deeply Christian.

For the present purpose I shall limit myself to the early Chapters of what may be considered the oldest Book, say the first and third Chapters of Genesis. Each of these accounts has certain inspirations and certain crudities of its own, but both have appealed to the heart of humanity, and represent the most poetic description that has yet been given of the origin of all things and of the character of man.

Familiar to everybody, they have sometimes been regarded as scientific statements of fact: as if it were possible for humanity to receive intelligible information about, or in the smallest degree to apprehend, the origin of all things!

Science does not deal with origins, not ultimate origins. It takes the Universe as a going concern, and tries to explore it; to see how one thing follows from another, to perceive the links by which they are connected, to discover the clue or thread which unites them, to follow them into the future, and to trace them back into the past; never proceeding to infinity either way, never proceeding to the ultimate future, never going back to the ultimate past. Time is of the essence of evolution: time is an element in a universe which as human beings we cannot dispense with, whatever its ultimate meaning may be. But time is infinite, and we are finite: we can only proceed a little way.

Poetry, however, imagination, can outstrip the limitation of science: poetry has a precision of its own, but it does not aim at a definite and precise statement of fact, it aims at calling up clear images, at stimulating the imagination

and the emotions; it may be infinitely suggestive, its very form is of definite value, and the words are precisely chosen. Lofty poetry is like a work of nature, in that it repays generations of study and interpretation.

Reason is a great faculty, the importance of which can hardly be over-estimated; but it is a mistake to suppose that it dominates the whole field: it is a mistake to suppose that it excludes other faculties. "There are two errors," said Pascal,—"to ignore Reason: to attend to Reason only." The Poet, the Seer, the Prophet, the Imaginative Artist, are not limited by reason; they are open to inspiration. What inspiration means has not been thoroughly defined; and it is just as well, for we cannot define things that we do not fully understand, but I believe that inspiration exists and is a reality. Ideas come to us that we have not evolved, or that we cannot trace back to pre-existing ideas. We are not the only beings in the Universe: there are those who know far more than we do, and can see further ahead and further back. How we get into touch with them we do not know:

some say in the watches of the night, some have said by prayer and fasting;—there are doubtless many ways. But the great works of art, and the great poems, are inspirations; and an element of inspiration is needed to account for the universal appeal to humanity of the great writings that have come down to us from the past. It is this which makes us appreciate the works of Shakespeare and Euripides and Tennyson and Browning. It is not the elements of crudity which make these things live: it is the divine and permanent element which suffuses and dominates them.

To regard the Book of Genesis as a scientific treatise, or an attempt at a scientific statement of fact, is an unlettered or illiterate blunder. We must regard those creation chapters as poetry, and dig out their inner meaning by getting below the crust of the superficial, the accidental, the mere skeleton on which the essential form is framed.

Looked at in that way, what is the essence of the first Chapter? First of all it is the perception that in the beginning of time—if there was a beginning, and certainly the earth and

solar system had a beginning,—there was the brooding of a Divine Spirit, a Mind at work, planning and executing. Some say, No: the process of evolution requires no mind, no plan. If any say that, they are in opposition to the inspired writing. They are going beyond anything they know: they are not rational, they are making a mere baseless assertion. If they say that evolution was the process by which the power acted, they would be right. There is an unfolding, a development: things do not come into existence all at once. As the tree grows from the seed, as the flower unfolds from the bud, the process is gradual, not sudden; time is involved. How much time is only a question of degree: things may happen in a second, things may happen in a century. How much time is a detail; but that time is involved is a fact.

Granting that, they will say, What evidence is there that there is mind acting at all, that there is any planning, any conceiving, any purpose: how do we know that everything is not automatic, haphazard, mechanical? I shall not argue against this; the only philosophers

who can think in this wise are the philosophers of Laputa, who sought to make books by throwing together letters at random. It is quite evident that there is nothing random in the Universe. Anyone looking at a work of art, or a bridge, or a cathedral, or even at the most mechanical thing, an automatic machine, cannot fail to see that mind has been at work. Look at one of those automatic tickers in the clubs, that reel out figures and letters on a tape: think of the ingenuity that has gone to the making, or rather to the designing and planning, of such a machine as that: no matter how self-working the mechanism may be. It might contain its own motive power, and might be actuated by a punched tape, so as to look quite automatic. Does that suggest that there is no mind behind it? Surely it insists that there is and must be. So anyone looking at an animal or a bird or bee, or any other of the contrivances which manage their lives so cleverly, so automatically, so self-sufficiently. Is there no Mind behind them?

Or again, with instructed intelligence, scrutinise the atom, its inner constitution, the way

it arranges itself into chemical compounds, and crystals, and worlds, and human bodies; here going to form a bone, there a muscle, again a skin, or an eye and ear,—all automatic, controlled by internal forces! Very likely. An automaton, however automatically it works, is the creation of mind, and the sign and evidence of it, to any but those whose minds are clouded, their apprehensions dull, and their intelligence limited.

And what is the next ingredient in that first-chapter Poem? That a cosmos sprang from chaos; that from the formless, out of the void, the world came into being and that Light made its appearance. How are we to interpret that creative Fiat, that great "Let there be!" in the more prosaic terms of science?

Consider what the world is composed of. Not this world only, but all the worlds, the whole host of heaven, "the heavens and the earth." Twenty years ago we did not know, to anything like the extent that we know now. We now know that the whole is built up of two units and two only,—the two minute elements of electric charge, the positive and the nega-

tive,—united by a third, an intangible something which goes by various names; its ordinary name being radiation, its popular name being light. The third thing is also called the ether,—but about that there may be controversy, which makes the term less appropriate to my present purpose. About radiation and light there is no controversy; nor is there any about the protons and electrons, which are the fundamental units of which all matter is composed.

These are the three things. Two united by one; and probably composed of one. Each is essential to the other. The atoms of matter are born from the two, and are united by the third. Save for the welding and unifying influence of the element called ether or radiation, the atoms of matter would be chaos. By the interactions of the three they have become the cosmos as we know it. How they originated, who is to say! Science does not deal with origins: even Poetry has to close its eyes when confronted with ultimate origins. It can only murmur the words "In the beginning, God."

Chapter III: General Reasonings About Existence

CHAPTER III

GENERAL REASONINGS ABOUT EXISTENCE

Or the Nature of Fundamental Generalisations and Inductions

(This chapter may be skipped by those who are not interested in logical processes and generalisations.)

THE logical process called Induction is an attempt to formulate a general law on the strength of observed instances. It is impossible for observation to cover the whole ground, past, present and future, and to deal with each case as it arises: so experience is summed up in a generalised and comprehensive statement, which, if accepted, is given the dignity of being called a law of nature. Such laws or generalisations or inductions are of the nature of aphorisms, and are employed as the major premises of a syllogism: All men are mortal. All swans are white. All planets are dark. Every star is bright. Every rose has a thorn. Every young animal has two parents,

etc., etc. It ought to be realised that such statements can always be criticised, and sometimes be upset by further experience. They may be true in a multitude of instances, and yet may occasionally fail. They have no coercive power over facts. If facts are discovered which disobey the law, it will have to be modified or enlarged accordingly,—sometimes altogether discarded, more often reformulated in a more cautious and completer form. Generalisations are of service if we use them properly, and do not over-emphasise them as final truths on the strength of long and uninterrupted experience. Inductions are guides to practice, not foundations for dogmatism. They have no validity against genuine facts.

An Aphorism, even if it takes only the more ordinary and unimpressive form of a Major Premise, is a generalisation or induction from experience. It is a formula which represents probable or plausible truth of a more general and universal type than any direct experience can actually give. It is always of the nature of an extrapolation—a travelling beyond the

range of actual observation,—it therefore always contains an element of hypothesis. Nevertheless such summary statements are useful, and are to that extent justified; they may be correct, but they always need criticism and frequent verification. They are in fact challenges thrown out to posterity, or it may be to contemporary workers. As if one should say, Point out the error, if you can: find a flaw in the formula: show me a case where it fails. And if you cannot do this, and see no hope of doing this, then admit that it is a summary fairly representative of truth, and be obliged to me for the trouble I have taken in formulating it.

If any aphorisms, like those in proverbial philosophy, are handed down from generation to generation through a long course of history, their survival is probably due to their having on the whole commended themselves to the experience of successive generations, each of whom may be taken to have informed its successor about them, and to have detected no certain and obvious flaw. Or if exceptions have

been discovered, they may perhaps be of the kind which prove the rule.

I do not know whether it is clear why exceptions prove the rule; but they often do. If for instance it was stated that no life had been lost in an earthquake, and then someone found that say a goat had been killed by it: that exception would make the previous statement still more forcible and striking. Or if a newspaper should state that no rain had fallen, say in London, for a given month; and then a meteorological expert with an apparatus for minutely measuring rain were to object that he had counted three drops to the square yard one morning; he would not be held to have upset the statement, but for all practical purposes to have confirmed it.

Very often the reason for the exception becomes quite plain after investigation, and is seen not to be really an exception at all; and then our knowledge of nature is made fuller and more precise by taking it into account. Thus a child or a savage, accustomed to the idea that everything falls, might be surprised to see a balloon rise. An explanation in terms

of the buoyancy of air, so that something was really falling all the time, would clarify his mode of regarding things. Gravity would still be dominant.

Some ancient generalisations are very comprehensive. Here is one commonly attributed to Democritus at a date like 400 B.C.:—"From nothing comes nothing. Nothing that exists can be destroyed. All changes are due to the combination and separation of molecules."

Take this sentence by sentence. *From nothing comes nothing.* Also known in the equally familiar form, *Ex nihilo nihil fit.* This might be taken as an attempt to negative the idea of Creation. If something was never produced from nothing, how on earth did existence begin? The answer I suppose would be, either that it never did begin; or at least that the conception of a beginning takes us out of our depth.

The statement may be interpreted, however, not as having any reference to creation or ultimate origin or genesis, but as a simple summary of experience, that we never see anything spring into existence *de novo.* Everything

which arrives, no matter how unexpectedly, can always be traced back to something pre-existent.

Those who uphold the orthodox doctrine of Creation need not object to the phrase, inasmuch as none of them would think of declaring that *nothing* existed prior to Creation. In their view the Deity certainly pre-existed everything, and can be taken as an adequate First Cause of all existence. Nothing has come from nothing, but everything has come at a Word, or Words, of Command. If that is the orthodox view of Creation there is nothing in the aphorism that even seems to contradict it. It makes no assertion about it either way, no theological assertion at all. It is a kind of negative statement, and need not be disputed.

Take the second sentence. *Nothing that exists can be destroyed.* It is obvious that this cannot mean that a letter, or a coin, or a flower cannot be destroyed. The existence thought of must be a fundamental and not an adventitious one. The destruction of any particular collocation of Matter,—tearing it into frag-

ments, or dissipating it into atoms, as for instance by violence or by combustion—is after all nothing more than the dispersal of a crowd. When a crowd is dispersed, the only thing destroyed is an accidental and temporary collection of human beings. When dynamite is exploded in a house, the separation of the components of the house is more violent but is of the same order. We may speak of the destruction of a planet by some cosmic catastrophe: and certainly the planet existed; but its atoms exist in a more fundamental manner, and exist just as much after the explosion as before. It is they which are really permanent, and, as far as we know, cannot be destroyed: only their arrangement can be altered.

But the question arises:—Can an atom of matter be destroyed? Can it not be resolved into its constituent electrons? Yes, that appears to be quite within the limits of possibility, and almost of knowledge. But that only proves that the atom was a collocation of something more fundamental than itself, that the fundamental existence is an electron, and that groupings of electrons can be scattered

like a crowd, without destroying anything except the grouping. Even suppose that in the progress of discovery we found that an electron was not permanent either, but was rather like a knot in the Ether which could be untied. What should we have to say then? Merely that the electron was not so fundamental an existence as we had imagined, though its constituent substance, the Ether, was.

Thus if we are willing to interpret the term "existence" as connoting only a fundamental kind of existence, then, so far as we know, nothing that exists can be destroyed. If the question ever arises whether any given kind of entity is permanent and indestructible, we should only have to ask, on this hypothesis, whether it really and fundamentally *exists*.

It used to be said that the two fundamental existences were Matter and Energy; and of late there has been a tendency to unify these two apparently diverse things. Without raising that large and technical question, we may say that Energy always preserves its fundamental character, and is still believed to be accurately conserved: though truly it may be

dissipated and dispersed in such a way that, for any practical purpose, it loses the character of available energy. Even so may milk be said to be conserved, when a can of it has been upset on the seashore. It is all there, among the sand: but as available milk it has disappeared. That is what is meant by the *dissipation* as well as the *conservation* of Energy. It can be dissipated as regards availability, but cannot be destroyed. Matter, even when broken up into electrons, might be still said to be *conserved,* though the particular meaning to be attached to that phrase would have to be somewhat modified from the positive and simple form we should have employed for it less than a quarter of a century ago.

Is there any third thing of which it is possible to assert conservation, and therefore permanence? It is a moot point. But the evidence is steadily growing that Personality is of that order, and accordingly that personality or character does not go out of existence, but is permanent. Here however we are entering on an argumentative field, where our footing is less secure.

Another thing of which conservation, and therefore persistence, is *suspected,* is Life. But no proof has yet been given to surmises concerning the nature of Life, nor is there as yet any final and crucial discrimination between them. Men of science appear at present uncertain whether Life is an actual non-physical constant entity which interacts with the material frame of things for a time and then evaporates whence it came,—which is one hypothesis; or whether it is a variable something which actually increases in amount under favourable circumstances,—as tested by its interaction with Matter. Or, again, whether it is only a fluctuating and indefinite summary or appearance, the outcome of a certain type of molecular organisation, so that when an organism has attained the right stage of development the phenomenon called Life makes its appearance *de novo;* and, when that organism is destroyed, that its life not only disappears, but ceases wholly to exist. That last is no doubt what it superficially seems to do, when tested only by our present senses, but we should have

learnt by this time not to be deceived by superficial appearances.

The third sentence, *"All changes are due to the combination and separation of molecules,"* must have been a gigantic extrapolation—or perhaps a mere guess—at that early period when it was promulgated. The same idea, or its essence, has survived in the minds of many scientific workers, and has constituted an inspiration and guiding principle in their work. Some would still accept it in full, including the words "are due to," though others would consider those three words rash and very doubtful. If we change them into "are accompanied by," the truth of the aphorism becomes much more probable, and perhaps generally acceptable.

To illustrate this:—If we said that all music was due to the vibration of strings or plates or columns of air, we should be saying more than we really mean; but if we said that all music was accompanied by vibration—at least whenever the music was interpreted or reproduced—we should be right enough. It would not necessarily be true of music while it was being

composed, nor even when the composition was being read by an expert. Music can be conceived in the mind, and is not *due* to the vibration that has to be used to display it. Even so may a Master of chess dispense with the rearrangement of wooden pieces, which yet are needed when he plays with an amateur, and which can be moved by an agent in obedience to his words of command.

So it may be said that all vital processes are accompanied by molecular rearrangement; and yet those processes may not be *due* to the rearrangement, which is employed for demonstration or realisation. It all depends on which is the primary fundamental essence—the life or the molecular process. Is the process initiated by life? or is life an epiphenomenon of the molecular operation? The question can hardly be considered closed even now; for there are not wanting biologists and philosophers who might take either side. There is no doubt in my own mind on which side the balance inclines; but to insist on this would be to dogmatise;—with reason doubtless, on a basis of

evidence, but the evidence is not at the moment before us.

A similar sort of statement can be made for "mind" also; for it has been regarded as a sort of efflorescence or excrescence or epiphenomenon, having no real existence in itself, but only appearing as a result or outcome of a peculiar kind of material aggregation. Consequently it can be held by orthodox science, in the teeth of certain facts which it does not accept as such, that the idea of the possible persistence of mind when its instrument or brain is destroyed, is hopelessly absurd. Indeed the word "instrument" will be objected to; and the theoretical assumption or generalisation or aphorism, that mind without brain is impossible, will by some physiologists be held sufficient to negative even actually observed facts, which appear clearly to demonstrate the survival of character and memory and intelligence after bodily death.

To such lengths it is possible to go, in the direction of *extrapolation* or plausible assumption, or insecure generalisation; so that not only can facts adverse to well-founded prejudices be ignored, but a sort of persecution can

be approved against those who carry on specially relevant experiments and study facts calculated to modify or overthrow ancient suppositions. It may be that we are gradually getting almost beyond that stage in this country, but some other parts of the civilised world are less advanced; and courage is required in those countries by conscientious truthseekers, when they combat universally or generally accepted axioms on the ground of enlarged though improbable experience.

Fortunately there has been in other directions an influx of orthodox scientific knowledge, especially in the direction of cosmogony, which however surprising—almost incredible sometimes—does not run counter to any but a very ignorant though well-meaning kind of popular prejudice, and is not (so far as I know) looked at askance by ecclesiastical and professorial authority; though a few centuries ago persecution was ready for the upholders of much simpler cosmic theses. We will now attempt a rapid survey of the most recent of these more welcome advances.

Chapter IV: Cosmic Evolution

CHAPTER IV

COSMIC EVOLUTION

IF we endeavour to reconstruct or follow in imagination the evolution of the physical universe as a process occurring in time,—an endeavour of very doubtful propriety, but which nevertheless contains many elements of truth,—we might proceed as follows: in spite of what we shall consider later to be the fundamental inappropriateness of limiting ourselves to a straightforward historical sequence. (Remember that we are dealing with the physical universe only.)

First we postulate an undifferentiated all extensive substance, the raw material out of which everything is composed, and which we call the Ether of Space.

We must then imagine this knotted up, here and there, into minute specks of two kinds, which we now call protons and electrons, the

positive and negative units of electricity; the knotting being accomplished by a process at present entirely outside our ken, to which as yet we have no clue. But we know that protons and electrons exist and that each has associated with it an electric field, diminishing in intensity with the inverse square of the distance from each nucleus; and thereby subjecting the particles to those attractions and repulsions which are familiar to First-year students of electricity, and are subsequently ignored by Electrical Engineers in favour of their powerful and doubtless more interesting developments. We must insist, however, that the elementary attractions and repulsions are themselves in reality exceedingly fundamental; they account for chemical affinity, the formation of molecules and solids, the strength of materials, and most of the phenomena of daily life.

Next we must suppose these electrical units running together under their mutual attractions, and grouping themselves compactly into close corporations, differing in number and arrangement, and forming in fact 92 different

patterns; the small ones consisting of a few units, others consisting of many. These 92 groupings constitute the atoms of matter.

Then these elementary atoms in their turn run together to form molecules, the molecules known to us as chemical substances; some molecules containing very few atoms, others containing hundreds. After this process the electrical forces are limited in scope; most of the lines of force of atoms inside a molecule are as it were saturated or satisfied: so that their power of attraction is limited to a very small range, the merest residue of chemical affinity, which nevertheless enables the molecules, when they come into close range of each other, to cohere and group themselves into solid masses of fair size.

The electrical forces have now done their work, and are superseded by another force, a new and as yet unexplained force; extremely minute when moderate masses are dealt with, but becoming very large in the neighbourhood of a great mass. This unexplained force is very familiar to us, the most familiar of all forces; because we live in the neighbourhood

of a great mass, namely the earth. We experience the force whenever we try to lift a body from the earth, and we call it gravitation. Among the large masses gravitation now takes the lead and is pre-eminent: so that the larger masses, long before they are individually what we should call large, fall together on their own account, and group themselves into immense clouds or gaseous regions, which we see existing in the sky as nebulæ. They may be rightly called gaseous; for the essence of a gas is that it consists of separate disunited particles, travelling about at random, independently of each other. Such particles or small bodies interfere with each other only during momentary collisions or encounters, which have the effect of deflecting their path in a perfectly random manner, but so that on the average the amount of energy in each particle becomes the same; the small particles acquiring greater speeds than the more massive ones, and thus compensating by velocity what they lack in inertia.

These great gaseous clouds, though they may occasionally intermingle and interpene-

trate one another (as has happened in our particular cloud, now called in its present form the Milky Way), are for the most part scattered about at enormous distances from each other, and carry on an independent existence. They are endowed with rotation. How that rotation arose is not clear; but neither is the origin of anything clear. All we know is that it could not arise from the mere falling together from practical infinity of particles originally stationary. But locomotion is one of the attributes of the particles, and rotation is one of the attributes of the masses formed by them.

Such a nebulous mass must be of enormous size, if it is to form an independent unit: for the only force which keeps its particles together is gravitation, and gravitation is only effective when the masses are enormous. From a small mass the particles would diffuse away. It does not matter how small the individual particles may be; they are attracted by the large cloud of which they form a part, whether they be small or big. There is no coherence among them, nothing like the behaviour of a solid or

a liquid; they are a gas pure and simple: but they are a gravitating gas, obedient to the gravitative attraction of the whole.

So far we have been trying to follow a process of which we have no real knowledge, and to which we can hardly apply calculation. But now we have come to a stage at which calculation becomes possible. It may be asked why several clouds should form instead of only one. It can be shown that a single universal cloud, if ever existent, would be unstable, and would break up into separate clouds of nebular size; and that these would have the masses and the distances apart roughly appropriate to the nebulæ as we know them. Following on that, the behaviour of a great mass of gravitating gas can be studied and followed in detail by mathematical skill. We enter now on the science of Cosmogony, in the modern developments of which we owe so much to the great mathematical physicists and astronomers who are now with us; of whom I will only mention two in our own country—Dr. J. H. Jeans, now President of the Royal Astronomical Society, and Professor A. S. Eddington, Past Presi-

dent, and Professor of Astronomy at Cambridge—and two in America, Professor H. N. Russell of Princeton, and Professor Shapley of Harvard.

The mass of gravitating gas is at first, while very extensive, fairly spherical in form, and rotating only slowly; but the particles are moving furiously among themselves, with the kind of unorganised motion which we associate with the terms heat and temperature. Accordingly, like every hot body, they are radiating; that is to say they are imparting some energy to the ether; which energy immediately travels away with the velocity of light,—that being the only way in which the unmodified ether can sustain extra energy.

But we are not to suppose that this loss of energy results in cooling; on the contrary it paradoxically results in heating at first; the temperature rises, for the particles keep falling closer together under their mutual forces. The whole mass contracts, and the potential energy of separation becomes the kinetic energy of heat. Thus more energy is generated than is lost, much more: so that the whole mass

becomes luminous and visible by what may be called the high-temperature radiation which it emits. But it diminishes in size, and as it shrinks it is bound to rotate faster and faster; for none of these effects destroy its original moment of momentum, a property which is conserved, being only alterable by forces outside the system, and by very few of them. As the speed of rotation increases, the mass bulges equatorially, becoming oblate like the earth. A great gaseous mass can become very violently oblate so that its equator presently becomes a sharp edge, where the centrifugal force balances gravitation. Hence if the mass is unaffected by outside bodies, a ring of matter will be left behind by the still shrinking central body.

A nebula, however, need not always remain so isolated as to be unaffected by outside influences: sooner or later it will feel the perturbing influence of another body, and then its equator will bulge at two diametrically opposite regions; an exaggeration of the way the earth bulges under the influence of the moon, giving our familiar two high tides. This tidal

influence, as Jeans has shown, will cause some matter to be ejected, not left behind as a ring, but emitted as two streams from opposite points of the circumference. These streams will then wrap themselves round the central body, forming what we call a spiral nebula; which must always be of enormous size, since the only controlling force is that of gravitation.

We then find that the two streamers are unstable and must break up into groups, or separate concentrations,—more or less spherical groups,—as a water-jet breaks up into drops when too long. The size of these nodules or groups has been calculated, and later measured, and by both methods has been found to be nearly or roughly uniform, each containing as much matter as goes to form a star. This is the process that we see going on. The nebula is the parent of a great constellation. In each nodule we are witnessing the birth of a star.

Each stellar mass, though undoubtedly what we call "big," is not big enough to imitate the behaviour of a nebula. It will nevertheless shrink or condense; and if too big, may sep-

arate into two or more, like an amœba; if moderate in size, it will remain single. Separation into two is very common, and has resulted in what we see as Double Stars. A star like our Sun has been able to remain one, although long ago it was much bigger than it is now.

The stars so formed will gradually retire from their parent nebula and take up an independent existence of their own. But still they are liable occasionally to outside influence; and Jeans has shown that under the tidal action of some other body, accidentally coming into the star's neighbourhood, a spindle-shaped stream of gas would be drawn from it, which would then break up into planets: small planets at either end, bigger planets in the middle. Which planetary masses would revolve round their primary, and, being comparatively small, would soon begin to congeal, so that the molecules would be no longer independent of each other, but would come within the range of each other's cohesion, and form a liquid, and ultimately a solid. One of the smaller of those solids is the earth: and this, according to our

present information, is thought to be the origin of the Solar System.

The nebula from which the Sun arose is supposed to be that which, proceeding on its course of stellar evolution, we now see as the Milky Way,—or perhaps we should rather say, one-half of the Milky Way. For evidence deduced by the great Dutch astronomer Kapteyn has shown that the Milky Way, which is our particular part of the cosmos, is the result of the interpenetration of two or more systems of stars.

The planetary masses are able to go through some further stages of evolution before settling down. The bigger ones, while still gaseous, can throw off streamers, which become small satellites; while a planet which is small enough to have become already liquid or pasty, may separate into two, and thus give birth to a moon. Our moon, by tidal action, has separated or migrated to a moderate distance from its parent body; but it remains near enough to keep generating tides on the still remaining liquid part of the earth. These tides have had important geological consequences, for they

scrape or chisel the solid features of the earth by their waves and currents, and thus account for many submarine deposits in the past. They continue their work, though now on a very reduced scale, to this day.

All this time the central Sun was radiating its energy into space, and is still; having passed through a period of excessively high temperature in which it radiated much faster: and we can attempt to follow the course of this long period of radiation. During contraction from the original nebula, the temperature was so high that the more complex atoms of matter either were never formed or were immediately broken up; such atoms are what is called ionized. Atoms can even be dissociated into protons and electrons, not completely but extensively; and accordingly, in the interior of such a star, electrical forces are dominant. The clashing together of the opposite electrical units will generate a great amount of radiative energy. This energy will balance the gravitative attraction, and keep the star swollen out to great size, so that it can remain a gas; a

gas, however, now composed mainly of simple atoms and of detached electrons.

But the energy of radiation has to be accounted for: gravitational shrinkage can no longer account for it; electrical forces must be appealed to. If we allow ourselves to speculate, and suppose that a negative and a positive unit can ever really clash together,—thereby, so to speak, annihilating each other, and reducing themselves to electrical zero,—we know that a flash of radiation would be produced, as it is always produced when an electrical unit undergoes a violent jerk or sudden movement. The process of generating radiation is most simply illustrated by the familiar generation of X-rays by the collision and sudden stoppage of cathode particles when projected against their target. Thus by the collision of opposite electricities—collisions more violent than any occurring in our laboratories—we should have the disappearance of matter and an immense production of radiation. The whole energy would be imparted to the ether: and though much would be re-absorbed, a part of it at any rate would escape from the region of matter,

and travel out with the velocity of light towards the confines of space,—whatever "the confines of space" may mean. I intend to signify, by the term, space far removed from our or any other visible or light-emitting cosmos, a region of what we may call infinity, quite unknown and inapprehensible by our senses. It we attempt to follow what happens to the waste radiation there, we are entering on a still further region of speculation, which has not yet been even touched upon by orthodox science, and a consideration of which for the moment I will defer.

Meanwhile let us return to the central mass, at its excessively high temperature, expending its substance in riotous radiation. "Expending its substance," I mean, literally. The Sun, when much hotter than it is now, as hot as Sirius, or perhaps even as hot as some of the still bigger stars whose temperature has been estimated at millions of degrees Centigrade,—the Sun must have been radiating away its substance, that is converting its matter into radiation, at a great rate. Now that it has attained maturity, and is even a little past

middle age, it is more sedate, though still pretty vigorous, as those who live in tropical countries know. From it the earth still derives all its energy; and what the earth receives is an exceedingly small fraction of the whole solar radiation. Even at its reduced rate of expenditure the Sun is consuming four million tons of its own matter every second.

Of course that cannot go on for ever: it is a question of arithmetic how long it can go on; —an interesting question, for upon that depends the prospects of the habitability of the earth and the physical future of the human race. Assuming that the account we have given of the source of the energy is correct, and in the absence of any unexpected cataclysm or incursion of another body from outside, the time can be reckoned within which the Sun would have lost say one per cent. of its present substance. The Sun's mass is so enormous that we may expect the time to be long: we should hardly have expected it to be as long as it comes out. The time required for the Sun to lose one per cent. of its substance, at the rate of four million tons per

second, is a hundred and fifty thousand million years,—a period of time in which almost anything might happen. And even then the Sun would be bright enough to make life comfortable in many parts of the earth; for it would undoubtedly still be able to remain gaseous, and therefore to continue freely radiating.

It was a surprising discovery of Eddington's that the Sun, which is already heavier than water, was still gaseous. Quite recently it has been found that by reason of the broken-up condition of atoms into constituent units of minute size,—the electrons and protons which occupy hardly any bulk,—the gaseous state can be maintained, and a body can still radiate freely, even when it has become a thousand times as dense as water; that is, when it is as much denser than rock as rock is than air. The star known as the Companion of Sirius is such a body: it is as massive as the Sun, and no bigger than a planet—say the planet Uranus: on it the force of gravity must be tremendous—two hundred thousand times what it is on the earth. A lucifer match would weigh half a hundredweight; a child would

be unable to lift it. A sovereign would weigh a ton. Whether the Sun itself will ever get into such a condition we cannot say; but even if it did that would not be the end. The Companion of Sirius is still radiating vigorously, still expending its substance, still shrinking; and so gradually, but very, very gradually disappearing.

Following out these ideas to their logical conclusion, it would seem as if the Universe, as a vital and active concern, must have had a beginning and must have an end. The beginning, so far as we can trace back the history, was the formation of the nebulæ two hundred million million years ago. The end will apparently be the disappearance of matter, and the existence once more of an ether filled with perpetual remnants of radiation, travelling out in all directions towards infinity; at a date incomparably more remote than any period of time we have yet mentioned or thought of.

But is this the end? Need there be any end, or any beginning, of time?

Chapter V: Cosmical Speculation

CHAPTER V

COSMICAL SPECULATION

IS there any end or any beginning of time? Were we right to follow out the course of evolution as a process in time? I said in Chapter IV that this line of thought was of doubtful propriety: I now want to emphasise that.

We are acquainted with the Universe as a going concern. We see things in all stages of evolution, not one after the other, but concurrently. We see the great spherical nebulæ as an early stage; we see the Companion of Sirius as a very late stage; and doubtless there are many objects which we do not see, because they have ceased to radiate, and grown too dark to affect our eyes,—these representing a still later stage. But all these stages are concurrent, co-existent. I ask, Has it not always been so?

There are Philosophers who think that time is a human abstraction, a form in which we are compelled to fit things; an aspect some think of space; or perhaps a thing *sui generis*, but humanly interpreted as time,—so as to account for what we observe as succession, duration, and the like. Are the operations in time, of which we have been speaking, really a sequence, or are they a co-existence? Were we right in thinking of a time, an epoch, at which the ordinarily known forms of matter did not exist; and again another epoch when everything will have been finally resolved into ether and radiation, and all energy dissipated? Or may we suppose that there is a recuperative process at work, the formation of matter as well as its destruction? Will there always be a transformation of energy, unabated, which will continue the activity even of the physical universe for ever?

The law of dissipation of energy used to teach us that sooner or later all the gravitative matter in the Universe would have exhausted its potential energy, would have done all it could do by falling together, and that the

end would be a cold lump of desolation. In that form the doctrine is not tenable. But is the idea of termination tenable in any form? I doubt it. But it may be asked, Have we anything to suggest, not wholly outside the limits of reasonable speculation, that would give us a line of hope? We may call it "hope," though it seems far removed from practicality so far as our trifling lifetime is concerned: and yet, like Carlyle's infinite shoeblack, we are not satisfied with anything short of infinity. Our cosmic view has an unconscious effect on our outlook, and even on our energies and aspirations. We feel bound to ask, What is happening to the radiation, which undoubtedly is now and has for millions of years been generated and travelling away into space? What is the state of things at the confines of space, far away from the luminous cosmos? What has orthodox Physics to say on the subject?

Well, here we have to take into account a singular phenomenon, the pressure of light; predicted by Clerk Maxwell, realised by Lebedew and by Nicholls and Hull in America, verified by Poynting, cosmically utilised

by him and by FitzGerald, and now still more extensively by Eddington. The pressure of light on small particles can overpower their gravitation and drive them away. As has been said,—the ether waves in the Universe sweep it clear of dust. There are undoubtedly myriads of small particles diffused and given off in various ways: and if they were allowed to accumulate, space would be opaque, hazy, a region of poor visibility. It is not so; it is absolutely transparent, or we should not see the nebulæ, some of them a million light years away. It is kept clean and transparent by light; by the pressure of light the particles are driven away. Where to? Where else but to the confines of space, whither the radiation itself is going. We will call it "the region of cosmic dust."

Now consider what happens when light of all kinds, ultra-violet light, X-rays, and all others, encounter a particle of dust; in other words an atom of matter. What happens has been investigated in our laboratories, and is known as photoelectricity. An electron jumps out of the atom, the atom is ionized.

This ionization of matter by light is becoming, or is likely to become, familiar in medicine. The photographic and chemical actions of light are constantly being studied, its action in polymerising sap in the leaves of trees and vegetation generally, the action of light on the skin also, and its familiar though remarkable effect on the nerve-supplied retina of the eye. How are these chemico-physical actions to be accounted for?—Surely by the photoelectric property; that is by the power of waves of the right frequency of vibration to eject an electron from an atom. An immense amount is now known about this process. Electrons are revolving in fixed orbits inside the atom, as conceived by Professor Bohr, and under the stimulus of radiation they jump from orbit to orbit as birds jump from perch to perch. An incoming wave can make them hop to a higher twig, or else fly away altogether.

This last process is called ionization; for the atom, having lost an electric charge of one sign, is now charged with the opposite sign: it is an ion; it is no longer neutral and inert, it is active and chemically fierce: it is no longer

satisfied, it seeks to combine with another. Chemical affinity is in full blast; and the molecular changes in protoplasm, in silver salts, and in the leaves of trees occur. In the retina the nerves are bombarded by the ejected electrons, each striking with an energy appropriate to the frequency of the received vibrations; thus giving the different colour sensations, through the extraordinary interpretative power of the mind stimulated by its organ the brain.

The destructive influence of this action on micro-organisms such as anthrax-bacilli, when they are exposed to ultra-violet light, is well known; and the health-giving power of these same ultra-violet rays,—at present so sadly and wastefully and thoughtlessly obscured by the atmosphere of towns—is constantly receiving more and more expert attention.

Surely here we have a region of Physics of great use in preventive medicine. A lavish supply of ultra-violet rays is sent us by the sun; it only remains for us to enable them to reach our bodies and our homes. We know how to generate such radiation in the labora-

tory also, and can use these rays for curative as well as for preventive purposes. A study of radiation—radiation of all kinds—has proved of late years intensely illuminating. Thereby that mysterious but fundamental entity, the quantum, has been detected; through that study the temperature, the constitution, the age, the speed, the history, of the various cosmic masses has been and is being elucidated; thereby the formation of wood, and the growth of vegetation on which animal life depends, has been explained; and now the sanitary and invigorating and beneficent work of sunlight on the human organism is being more and more appreciated, and more and more studied and applied by those who have the requisite training, who will watch for the dangers of excess, and regulate the application of any kind of ray with patience and wisdom. I hope that a recognition of the electric and ionizing power of such rays, which I urge as a reasonable explanation of their chemical and physiological activities, may be a hint in the right direction to those engaged in this work.

Reverting now to what I was beginning to

deal with, viz., the hypothetical effect of stray or apparently waste radiation when it reaches the confines of space and encounters the supposed age-long accumulation of cosmic dust, which pictorially and for our present purpose we represent as more localised than it is at all likely to be. It may be said that the light, when it has travelled to those enormous distances, will be too feeble to do anything. But apparently it is not so. The jump of the electron is effected, not by the energy of the light, but by its frequency, its rapidity of vibration: and that is just the characteristic which it will retain unaltered, no matter how far it goes, or how weak it gets. Light of the critical frequency—which depends on the nature of the atom and the position of the electron in it,—will be able to ionize it, however impoverished by wide-spreading the light is.

It is true that the number of electrons liberated depends on the intensity of the light, though the energy of each does not so depend. If the light is very weak, the number of ions formed will be few. But the area available is enormous: nothing like such an area of matter

exists in the visible cosmos; if only one or two ions a second were formed per square kilometre, the loss of matter from millions or even billions of suns could be compensated.

Now consider what happens when an atom is ionized. It has lost a negative charge: it has therefore become a positive ion. The negative charge has gone away, and will attach itself to some other atom, which thereby becomes a negative ion. Sooner or later the two may meet. They will not discharge into each other; that is not what happens; they will combine to form a molecule, a chemical compound. The process of Chemistry has begun, under the influence of light.

We are evidently returning to the stage at which we began the consideration of the course of evolution. Radiation gives up its own being, the energy takes the form of electrical separation. It then takes the form of chemical combination: aggregates of matter are formed. And this aggregation may go on until the particles are big enough to feel the effect of the gravitative attraction of the far-distant cosmos. No longer will the particles

be sustained and separated and driven away by light. They are now big enough to have effective weight; and slowly they will begin to make their way back; bringing with them in potential form the lost and radiated energy; and so begin once more the clash of atoms, the formation of nebulæ, the birth of stars, and ultimately of planets.

It may even be that fresh matter, in the form of electrons and protons, can be generated by radiation, apart from its photoelectric effect on already existing matter. To me this seems not unlikely, though it is outside our present laboratory knowledge: of that process of "beknotting" in the ether we have as yet no inkling. A knowledge of that may come, but not yet. Meantime, in photoelectricity, we have something which, if not sufficient, seems at any rate a step towards reconstruction, rehabilitation, regeneration.

Psychical Speculation.—Apart from only partially justified physical speculation, I would urge that creation is a continuous process, not going on once for all and then stopping, but continuing now, and always continu-

ing: that what we are confronted with is not really a succession, a series, a beginning and an ending, a past and a future,—but in some sense an eternal Now. The greatest Name ever given to the Deity in old times, the greatest inspiration of Moses, and one that was adopted (and as far as I know the only one adopted by our great Exemplar) was the name I AM,—which suggests a universal present, an eternal now, without beginning or end. The physical universe, which has been poetically called "the living garment of God"—der Gottheit lebendiges Kleid—may among its other attributes have this also. It is not for us creatures of a day to understand such an idea fully; but it is coming within our mental conception.

Some may feel this doctrine of cyclical working depressing, and ask, Is there then no progress, no increase of value, no real improvement, nothing but a universal level of uniformity, so that what is always has been and always will be, not only without change and decay, but without rise and advance? That is not the deduction that we are entitled

to make. For remember that we have been dealing with the physical universe only: we have not touched on the universe of mind, soul, spirit, or any of the emotions and faculties of man. We have been studying the course of physical evolution, and have imagined it as evolving in a cycle. I believe that to be the essence of the physical universe, it follows a cycle, round and round;—the plant assimilating inorganic materials, elaborating them into food for animals, the animals returning them in the inorganic form, ready for the plant. Energy taking the potential form, then the kinetic, then the potential again, and so on alternately for ever. Water evaporated, rising as vapour, then falling as rain, getting back into the sea, and being evaporated again. Everywhere we find a cyclical process in the material universe.

But what about the mental universe? Surely there we find growth, development, increase of value, rise in status; the lower organisms becoming intelligent creatures, then developing into man? And what of man? If his death is the end of him, the value of his

existence may be doubtful. But if, as I know, death is not the end of him, then there may be infinite progress in store. The cyclical machinery of the physical universe is employed to develop value in the mental and spiritual universe; just as the revolution of a fly-wheel may be the means of turning out a woven fabric of beauty and design. Some fabrics may age and turn to dust: but not so a poem or a piece of music: they have in them the seeds of immortality, and if great enough will last as long as humanity endures. All fundamental things last for ever, if what we have been saying is true; but while the physical things last by a kind of evolution of cyclical change, the evolution of spiritual things has no necessary regress. They can advance continually through higher and higher stages towards perfection. This, I take it, is the real meaning of Evolution. This is why the physical universe exists. This, surely, is the real aim and purpose of the ultimate and infinite term "God."

Chapter VI: The Evolution of Plants and Animals

CHAPTER VI

THE EVOLUTION OF PLANTS AND ANIMALS

THE particular method of evolution as regards plants and animals, studied and formulated by Charles Darwin, involves a number of technicalities on which my opinion would be of comparatively no value. It makes use of the fact of heredity, and the fact of individual variation, and discusses how far new species may arise in the ordinary course of unconscious competition and natural survival of the fittest. It does not account for the origin of variations, nor for the facts of heredity: it takes them as facts, and proceeds to their consequences. Like all partial theories it is liable to be modified, supplemented, improved on, perhaps even discarded (though it is unlikely to be completely discarded) by advance in knowledge.

Whatever may be the history and fate of the

Darwinistic theory in its narrower sense, there is no reasonable doubt that evolution represents the method of Creation—the method, that is, by which things change and improve and come into existence. Nothing comes into existence full-blown in its final form: everything has unfinished stages and imperfections, through which it has to pass before attaining the complete result. We see the process in the individual, as when a seed becomes a plant or a bud a flower; and the rocks are full of vestiges of animals and plants which show that the gradual process applies also to the race.

We cannot legislate as to the method of Creation by trying to impose our own ideas of what is fitting: we have to ascertain what is, and what has been. *Time* seems of the essence of the problem; and evolution signifies a gradual development, a gradual growth in value, so that things become more and more adapted to their conditions and surroundings. These changes are matters of fact, not of theory; and it was on the basis of fact that Darwin formulated his famous (though confessedly incomplete) hypothesis, which he ap-

plied not only to plants and animals, but also to man. The fear of evolution felt by some people is a fear that such an origin for man is beneath his dignity, and that it is opposed to the notion of a creative Fiat. (See end of Preface, about what follows.)

Judging by analogy, as we must, there is no such opposition when the subject is properly regarded. Every work of art, every engineering structure, is first conceived in the mind and then reproduced in matter. There is always a "Let there be." The process is always a gradual one, and the steps in human creation can be traced. The steps in divine Creation are less obvious: they require study by those who are competent; but the method, so far as we can follow it, seems to have the same general characteristics. There is no haste or suddenness of operation, everything is obedient to what may be spoken of as divine law, and gradual evolution is the universal method.

The work of Creation is not something in the past, which occurred and then stopped: it is a continuous process. The same Power

which brought the Universe into existence is regulating and controlling it, subject to Self-imposed limitations which brought conscious beings into existence and endowed them with free will and with power of a very limited kind. This free will and this power enable them, if they are willing to assist and accelerate, or to obstruct and oppose, the increase in value and thereby to take their due share in the intermediate stages towards ultimate and far-distant perfection.

Were it not for our perception of this gradual method the present state of mankind would be depressing. The opposite to evolution is stagnation, which would mean the abandonment of hope. Evolution is a discovery full of hope. We know more or less what we are, we know not what we shall be; but we realise that the result depends partly on our own exertions,—aided and helped, but not compelled. The whole creation works together towards some great end, and happy are those who realise effectively that they can be co-operative agents, even to a small degree, in the mighty process.

"Yet I doubt not through the ages one increasing purpose runs,
And the thoughts of men are widened by the process of the suns."

So far we have been dealing with the region of the inorganic, the atoms and the forces which unite them, and the formation of worlds; the reduction of chaos to cosmos, suffused with law and order; the same law and order, the same Physics and Chemistry ruling in the most distant star as in the earth. There is not one law for the earth and another for the heavens: the earth itself is one of the heavenly bodies, though a small one, invisible and unknown to any dwellers there may be in planets circulating round one of the stars. All that they would see of the solar system would be the Sun; and that would appear as a star just like the others. Any inhabitants there may be on our system of planets see the same constellations as we do, without any perceptible difference; since, though they are far removed from each other, they are immensely further removed from the stars. So also dwellers near

many of the stars would see the same Milky Way and the same general aspect of the sky.

Now we enter upon a more difficult problem, the origin or evolution of life: and we touch upon the great science of Biology, on which in detail I am not competent to speak. What I am sure of is that the same Physics and Chemistry hold sway in the interior of an organism, just as they do in the most distant parts of space. There is not one law for the organic, another for the inorganic: we have a right to apply all we know of science to the workings of the organism, as a wonderful piece of mechanism, with the recognised forces supplemented, not replaced, by the agency of life. The details of the mechanism, and the history of the stages through which life on this planet has passed, fill volumes. It is hopeless to compress any account of it into a summary: it is a life-study.

We all know however that evolution has been the inspiring key-thought of Biologists now for many years. They do not attempt to explain the origin of life: they take it as an existing fact, just as we take the existence of

matter with its electrical and gravitative forces. We do not really know how the different species originated: that is still a subject matter for controversy. What they have taught us is that natural selection and the survival of the fittest, in combination with the laws of heredity, must be a potent factor in clinching or perpetuating any favourable variations which may make their appearance. There are difficulties even about this. Some think that the utilisation of an organ contrives to strengthen that organ and hand it down to posterity with gradual improvements and developments. Others think that such acquired characters cannot be passed on, and that only the innate or inborn characteristics, however they originated, are transmitted to offspring. As to the origin of "variations" we are still largely in the dark, in spite of a great accumulation of knowledge and admirable work.

We learn a good deal about evolutionary history from Geology. The strata in the earth's crust are an epitome of the stages through which it has gone, and relics of animals and vegetables which lived at each period

are found preserved as fossils in the rocks. Moreover our own bodily structures, our skeleton, muscle, and internal arrangements, are practically identical with those of the animals, differing from them no more than they differ from one another. Some of the four-handed animals are literally our blood relations according to the flesh.

Another way of learning the history of development is by the study of embryology: each individual recapitulates rapidly the evolutionary process. At a very early stage the human embryo and the embryo of a tadpole are very like each other. Later it passes through further animal likenesses. Undoubtedly the human *body* is inherited from the rest of the animal kingdom.

Do not be alarmed or disquieted about this: it is a discovery of hope, and accounts for many of our difficulties. We have to overcome the relics of animal ancestry, and work out the ape and the tiger. That some fail is natural —the wonder perhaps is that so many succeed. We must never shy at truth, and as far as history goes the record is clear; though the

method by which different species originated, the reason for all the vast variety of living things, is a problem not yet solved.

Do not be alarmed at any of the results of science. We are out for truth; and to shy at or resent truth is to show a lack of faith. We may make mistakes—of course—but we shall correct them. We must trust the experts to get as near it as they can. That is their object, and they correct each other. Biologists at present speak among themselves with diverse voices; so that we are justified in assuming that they have not yet completely solved the problem. What they are all sure of, and what we may be sure of, is that the process is a gradual one, and that nothing is accounted for save by gradual steps involving great tracts of time.

We can however follow the course of evolution to some extent, in the case of such an organ as the eye for instance. It began low down in the animal kingdom—and even as some think in some exceptional groups or orders of the vegetable kingdom—as a sensitive spot on the surface; a spot which responded

to ether waves in the way that many inorganic materials respond, that is to say in a photo-electric manner, the atoms throwing away electrons under the influence of light, and entering into new combinations. Such a sensitive spot, once originated, would be advantageous, and would tend to persist: it would give its possessor some advantage in the struggle for existence. But unless protected, it would have also some disadvantages, for it would be sensitive not to light alone: if it had any nervous mechanism associated with it, it would be sensitive to pain and damage. Accordingly it would sink or retreat beneath the surface, lining a hollow cavity, which would to some extent protect it from contacts and mechanical disturbance. The cavity however must have an aperture through which the light can enter; and such a cavity or small orifice would have the further advantage of forming on the sensitive screen a sort of image of the external world. It would not exactly focus objects on the sensitive surface, but it would cast an anti-shadow, which would have much the same effect. A pin-hole can be used in photog-

raphy: it gives on the sensitive plate what is virtually an image of outside things; and, though requiring a long exposure, it is sometimes used in the photography of buildings, and other stationary objects for which a long exposure does not matter.

A lens however would be an improvement; and sooner or later, in some strange manner, a lens formed in the orifice, as a suitably shaped piece of transparent material, formed apparently from the epidermis. Then, as the light might be too strong, a screen developed behind the lens; an adaptable or adjustable screen with a variable orifice, which automatically adjusts either its size or shape, or both, in accordance with the intensity of the light: the screen being now called the *iris,* and the aperture the *pupil.* The interior of the cavity also became lined with black pigment, such as we artificially line optical instruments with, for the purpose of absorbing stray light that would only confuse the clearness of the image. Thus gradually, but still at a surprisingly low stage in the animal kingdom, the eye of birds, beasts, and fishes developed; until it attained

the extraordinary perfection of the eye of an eagle or of a man.

We are not able to follow the evolution of all organs with the same satisfaction and facility; but we may reasonably take it as a type of the kind of thing which must have happened in other cases, and be satisfied that the outstanding puzzles, which undoubtedly exist in connexion with some of them, will some day be solved.

Thus then the attempt is being made to follow out the details of evolution in the animal and vegetable kingdom. The flower is supposed to be conspicuous in order to attract the fertilising attention of insects. But why the flower should be beautiful, instead of only gaudy, is not explained. Nor indeed does the element of beauty and the æsthetic enter into the domain of Biology at present. Beauty is an attribute which must have extreme significance: utilitarian ideas cannot wholly explain it; it seems to represent a joy in existence for its own sake. Without it, existence would not have the value that it has. Indeed the whole idea of "struggle for existence" suggests that

existence must be of immense value. And the element of beauty must be one of the contributing causes of that value. Who does not rejoice in beauty—the beauty of face and form? It has been the inspiration of Artists, and even to us is of untold unspeakable value.

But the idea of "value" belongs more to Philosophy than to Science: the course of evolution has been described as a process of increasing values; so that ultimately the mere life with which we started develops into mind and consciousness and the power of appreciation. So begins the pursuit of beauty, and the production of it by human effort; thus carrying the process still further, into works of art,—music and poetry and sculpture and architecture and the rest.

Beautiful architecture begins indeed low down, even among the birds; though whether they have the power of appreciating their own nests or their own songs, we cannot say, though it seems not unreasonable to suppose that they have. Anyhow *we* have; and so consciousness and appreciation have come into existence,—not merely the power of doing, but the power

of appreciating and loving. This is the real meaning of Art: the decoration which the human artificer lavishes upon his work is a sign of joy in the work for its own sake. And to many it has seemed that the beauty lavished on the world around us, the beauty of mountains and sunset and lake and forest, and of everything we see when we look with appreciative eyes at a landscape—away from the spoiling influence of half-finished and incomplete human activities—is a sign and demonstration of the Joy of the Creator in the Universe which by long and patient process has been caused to come into being.

We see not only beauty, but adaptation, the continual evidence of design and purpose. We see this in innumerable ways; we may take as an example the mutual adaptation of animal and plant life. The one is essential to the other. Without the plants we could not exist; for they furnish us with food. Without us, their existence would be imperfect and limited; for they would not long have the raw material with which to compose their structure. They supply us with oxygen, we supply them

with carbonic acid. We feed upon them, and they, so to speak, ultimately feed upon us. The whole of organic nature is welded together into a harmony, which we may well think to be a pre-established and designed harmony.

Still the incoming of life is unexplained. How it arose is at present a mystery. We can picture the molecules becoming more and more complex, more and more elaborate, under what we call the vivifying influence of light. We know that light can produce vegetable substance from inorganic materials: the thing has been done even in the laboratory. We can perhaps form protoplasmic material, but not living protoplasm. The element of life only enters it as the result of antecedent life: the germ of life must be handed on. And if we ask how the first germ arose, we cannot answer. Not yet.

But by all means let us be ready to receive and welcome the information when it comes. Ignorance is not a thing to rejoice over, but gradually to dispel. To me it seems that life is not explicable in terms of Physics and Chem-

istry, or in terms of atoms and their forces: it seems like something added from outside, entering into the scheme when the molecules have become sufficiently developed to receive it. It is certainly a guiding and controlling entity, which utilises the energy of the material universe, and directs it to its own ends. But its nature and origin can only be, for the present, speculation, not science. Scientifically we do not know how life entered into the scheme; but we know that it makes use of the energy which is received from the Sun. It does not add to that energy: it directs it. Life is not one of the forms of energy, it is *sui generis*, it does not appear to be explicable in terms of something else: nor is it transformable into anything else. It must have begun at a very low stage, giving to a cell of protoplasmic material a kind of spontaneity of its own, a power of self-movement; subject to the laws of energy but supplementing them, and not entirely explicable by inorganic forces. Life is a controlling and directing influence, producing results which otherwise would not have occurred, such as spontaneous movement, climbing

against gravitation, absorbing foreign elements and incorporating them into its own specific substance; gradually thus growing, until too large for convenience, and then splitting up into two or more individuals; which continue their existence, and in turn split up into further descendants. The power of reproduction is characteristic of life.

Such a uni-cellular organism seems to have been the beginning; but the cells, like the atoms, had the power of matting themselves together into a larger mass. Then began a process of differentiation, well adapted to their mutual advantage. Some of the groups of cells became stationary, rooted, fixed to one place, receiving what was brought them by stray currents, absorbing some and rejecting the rest: others freely locomotive, beginning to hunt for food, getting into danger, and developing a sensory apparatus for their protection and to assist their hunting power; thus beginning the rudiments of what we know as our sense organs. The first group would be the ancestors of the vegetables, the second group the ancestors of the animals. And thus

in the course of ages the whole animal and vegetable kingdoms, with their extraordinary variety and wealth of existence, gradually developed or evolved.

The process is poetically described in that first Chapter of Genesis. After the formation of light, and of dry land and sea, the Fiat went forth:—

Let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit after his kind, whose seed is in itself, upon the earth: and it was so.

Then comes the other branch of the tree of life:—

Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament.

And again:—

Let the earth bring forth the living creature [the land animals], cattle, and creeping thing, and beast of the earth after his kind: and it was so.

What fundamental objection need we insist on against this brief description of a process still largely inaccessible and barely intelligible even to us, who have learnt far more than the ancients knew? What fundamental antagonism is there between the inspirational and the scientific account? Surely none except that in Poetry the whole operation is dramatically regarded as if it occurred quickly, in the twinkling of an eye as it were, in a single day. The element of time, the succession of events, is admitted, but the amount of time need not be dwelt on: that is a detail for subsequent exploration. No doubt the writer thought that the process was quick; though what we mean by "quick" and "slow" is still uncertain. Our unit of time is our human life; everything much shorter than that seems quick, everything much longer seems slow; but as I have said before, what the ultimate nature of time is, is unknown to us. We are living in Eternity, and the Poet has told us, in suggestive words, that "a thousand years is as one day," and one day in the eye of the

Eternal no different from a thousand years. Aye, or a million years either.

Science is now able to estimate the age of the rocks, the age of the earth. The earth was once without form and void; and that epoch is now estimated as a thousand million years ago, —not less than that,—an immense tract of time, truly, almost incomprehensible to our finite minds; and yet from another point of view a sort of flash, a moment in eternity. What went on before the earth was formed we have tried to follow: what goes on after that, we in our own individuality may live to see, for there is evidence that we are no ephemeral beings. We are still very imperfect, still in our infancy; but we have just got to the stage when we can appreciate the wonders of creation and try to follow out the process in some detail. That we make mistakes is inevitable: the wonder is that we can form these conceptions at all. The world and its animal and vegetable kingdoms constitute a great fact. We now have to follow the still further, still more striking, still more miracu-

lous and inspiring process, the evolution of man.

Through it all the eye of faith discerns the Presence and Activity of a controlling and dominating and guiding, a transcendent and yet immanent, Power; the great I AM operating in an eternal present, an eternal Now. A Being beyond our utmost thought the Unknown God whom we ignorantly worship;—Who for us men and for our salvation has been revealed to us as a loving Father, able to attend—not to the majesty of the heavens alone, but also to the smallest detail, the humblest individual—to the lilies of the field, the fall of a sparrow. Of whom as poets have said, "we also are his offspring,"—part of the fabric issuing from his majestic Loom.

Chapter VII: The Evolution of Man

CHAPTER VII

THE EVOLUTION OF MAN

REVERTING once more to the first Chapter of Genesis, you will have noticed that the order of events narrated by the Poet—if we eliminate what was beyond anybody's conception at that time, such as the formation of the stars, the sun, and the moon, —follows a reasonably correct order; first some grade of plants, then what we may call water beasts, and then land beasts. For it is true that animal life began in the water:— Sea water is the mother of living creatures, as Kingsley said. The water creatures gradually rose, with many off-shoots and branches, such as the Crustaceans (which tried putting the hard parts outside, as a means of protection, a plan which turned out inconvenient and troublesome, because they outgrew their shells, and had to go through a dangerous period of

change), gradually rose, I say, to those which put the hard sustaining structure inside, with the soft parts outside; thus beginning what we call the Vertebrates, which were destined to succeed in the struggle for existence.

These creatures then rose to be fish, with great powers of locomotion, with fairly developed sense-organs, and able to breathe the oxygen dissolved in the water. At a later stage some of these crawled out on to the land, gradually shed their gills, and developed air-breathing lungs: thus having an amphibious existence, the early stage in the water, later stages on the land. The first truly land animals were the lizards or reptiles, some of which took to the air and became birds; while others of the amphibian class found a new way of protecting and hatching their eggs internally, and a new way of feeding their young, and became mammals,—which are in the line of human ancestry, and are comparatively late comers on the planet.

Naturally I do not wish to stress in detail any correspondence there may happen to be between the poetic anticipation and subse-

quent ascertainment of fact,—I stress the correspondences no more than I stress the discrepancies, they are all unimportant—but it is rather noteworthy that in that ancient Poem no special "day" is allotted to the creation of man. He is represented as, so to speak, originating in the evening of the same day on which the land-animals, the mammals, originated; the special distinction given to him lying, not in a special variety of bodily form, but in the soul, the divine image implanted in him, the germ of that spiritual development which now became incipient and possible. His superiority and intelligence are indicated by the "dominion" granted him, and by the seeds of divine life which were planted in him, infusing his animal organism with infinite possibilities. Thus man was raised far above his bodily ape-like ancestors, and felt like a new creation: which from a spiritual point of view he was.

The initial stage of spiritual development has been described or suggested by a modern poet, the late F. W. H. Myers, in his conception of what early man must have gone through before he became conscious of his own latent

powers, and of the still higher Powers to which he was akin. Just as life intruded itself or infused itself into the inorganic material world at a certain stage of evolution, so mind and consciousness dawned upon life at a later stage, until the rudiments of art, and language, and even of religious feeling and aspiration gradually arose.

"Through such fierce hours thy brute forefather won
Thy mounting hope, the adventure of the son:
Such pains astir his glooming heart within
That nameless Creature wandered from his kin;
With hopes half-born, with burning tears unshed,
Bowed low his terrible and lonely head;
With arms uncouth, with knees that scarce could kneel,
Upraised his speechless ultimate appeal;—
Ay, and heaven heard, and was with him, and gave
The gift that made him master and not slave;
And some strange light, past knowing, past control,
Rose in his eyes, and shone, and was a soul."

We cannot really follow the whole process of man's evolution, which must have been very gradual. We find some rudiment of mind low down in the animal creation, to the extent of planning and contriving, hunting, laying snares, storing food for the future, migration according to season, and the admirable trait of parental love and care for the young. All

which we summarise under the term 'instinct"; meaning a mental development apart from full consciousness, an instinctive semi-automatic adjustment to the environment, combined with an alteration of the environment to suit the individual and the race. We find this instinctive care for the future, and for the well-being of descendants, highly developed among the insects; we find it also among the birds, and among the mammals; each class displaying parental care in its own way.

At some stage, a special kind of consciousness must have begun. In the higher animals which we have domesticated we trace some already human characteristics; notably a recognition of men as higher beings, a kind of affection for them, which we may sometimes dignify with the name of love, culminating in ideas which are not very different from what we call worship. This is conspicuous in a dog in relation to his master, and leads even to a sense of wrongdoing, which we may perhaps figuratively describe as a sense of sin, followed by a sort of repentance or at least expectation of punishment.

These higher faculties must have shown themselves more markedly in some early human ancestors; still mingled with much savagery, much fierceness, many animal traits. For they had before them a most difficult task: they were set in the midst of many and great dangers; they could not always stand upright; they had to strive with adverse circumstances, and dangers from the other creatures among whom their lot was cast: and it was only by their intelligence that they managed to survive in the struggle. To those early ancestors of ours we owe much.

Well above the mere struggle for subsistence, however, among those primitive men (some of whose descendants survive almost to this day) we find an imagination which carried them beyond the mere indications of the senses, a feeling that really Higher Beings must exist although they were not directly apparent. They suspected with awe an unknown power by which they were surrounded, a mysterious Something which could be placated by submission and sacrifice, and which could be appealed to in emergencies. So de-

veloped a sense of worship of the unknown, a dim feeling or groping towards what we now recognise as Religion, however crude in its early stages—yes and however crude in its later stages too—such Religion might be.

If we suppose that we have attained to perfection in a development such as this, even now, we are surely mistaken: relics of crudity remain. In the enormous tracts of time during which the world has lasted, the development of man has been a recent event,—how many thousand years ago we must ask the Anthropologists to tell us. It is not easy to specify at what stage the developing creature might be called human: but I think all agree that it is only a case of thousands of years. Perhaps fifty thousand, perhaps a hundred; but a short time: we are no longer dealing with the millions of centuries which preceded this portentous outburst of human attributes and full consciousness; nor can we say that in the great bulk of humanity such a development has yet completely occurred. It is still in process of development. So far as humanity is concerned we are still in the morning

of the times, the human race is still in its infancy. Still we are feeling after God if haply we might find him. Still the sense of worship is latent, full of crudities and imperfections: and in spite of the imagination of the leaders and geniuses of the race, and in spite of their great and manifold achievements, we have still much, much to learn. Our conceptions are almost infinitely below the greatness of reality.

The growth of the human soul, like the growth of the human body, must be a slow, laborious process, involving great tracts of time. Here and there a genius arises, and towers above his fellows: and the higher he rises, the more convinced he is of his own imperfections. But the great bulk of humanity is far below that level: as Browning says at the end of his great Poem PARACELSUS, likening it to the appearance of the stars as they emerge one after the other after sunset:—

". . . . man is not Man as yet.
Nor shall I deem his object served, his end
Attained, his genuine strength put fairly forth,
While only here and there a star dispels
The darkness, here and there a towering mind
O'erlooks its prostrate fellows: when the host

Is out at once to the despair of night,
When all mankind alike is perfected,
Equal in full-blown powers—then, not till then,
I say, begins man's general infancy."

This view is one of great hope and encouragement; for it accounts for many of the evils and troubles in the world. "God's in his heaven, all's right with the world,"—yes, in one sense. All is ultimately right: we are on the path to higher things. But we have not yet attained them: the structure is incomplete, unfinished, in process of construction. The world is like a builder's yard in which an edifice is rising that may ultimately be beautiful, satisfactory, complete; but now it is covered with scaffolding, its features can hardly be discerned, a mass of builders' material and apparent rubbish is lying around; all which however has its part to play, and is a necessary stage in the development of the ultimate fabric.

The human race began but a short time ago; it may have millions of years before it on this same planet. It is calculated that the sun will only have lost one per cent. of its sub-

stance—will be only one per cent. less bright —in one hundred and fifty thousand million years. If the earth lasts as long as that—what may not happen? "It doth not yet appear what we shall be." The remarkable thing is that we have become conscious helpers in the process; the reins are being partly given into our own hands; the rise of mankind depends partly on our own exertions, our own goodwill, our own perceptions and aspirations and efforts.

That is what the churches are for; it is towards that that all the good work done throughout each City, and in all parts of the civilised world, is aiming. Surely we may take heart and realise, not only the faults and shortcomings, which are inevitable, but also the manifold efforts towards good, which are being made. Let us rejoice at the vast amount of friendliness and good feeling and mutual help and co-operation, and the earnest desire for better things which is permeating so many. Many can now be regarded as co-workers and co-operators with the Deity, in bringing his great patient long-suffering scheme nearer on

its way towards that ultimate perfection which, so far from as yet being in our grasp, is hardly within the scope of our imagination.

We are troubled by the problem of Evil: we wonder how it arose and why it is permitted. Let us be thankful that there is no problem of Good: we never ask why so many things are good and beautiful. We take goodness as a matter of course. We see evil as its shadow. As Browning says:—

"The evil is null, is nought, is silence implying sound;
What was good shall be good, with, for evil, so much good more;
On the earth the broken arcs; in the heaven, a perfect round."

Remember, moreover, that Evil has within itself the elements of decay, decadence, self-destruction. Good it is which has the elements of persistence, survival, permanence, value. Truth, goodness, beauty; these are the things which shall endure. We see beauty as of gems and crystals in the inorganic world, beauty in the birds and flowers; we see beauty and goodness also in the heart of humanity. We see them in the heroic efforts of quite ordinary peo-

ple to help their fellows in times of danger and distress, in fire, in colliery disaster, in shipwreck, even at the expense of their own lives. We see these enduring things in the mother-love which is the most sacred feature in the animal creation, without which infancy would be impossible and no race of higher beings could survive. We see them in the institution of the family, all of whose members are tied in bonds of affection and mutual assistance: and we hope for the time when all humanity will become one family, not competing with one another, but stretching out hands of help to each other, and mutually overcoming the difficulties of material existence in a spirit of amity and brotherly love. So will gradually come the Kingdom of Heaven upon earth.

All these things are possible; these things will surely come; we may have faith that they lie in the womb of the future. We have faith that God *is* in his Heaven, and that ultimately all will be right with the world.

Chapter VIII: The Perfecting of Man

CHAPTER VIII

THE PERFECTING OF MAN

MEANWHILE let us go back to the evolution of man in his early stages, and on to further stages in the development of the human soul. What is it that first separated man from the rest of the animal creation? Surely it was his sense of free will, the power of choice, the knowledge of good and evil. Apart from domesticated animals, who have learnt something from their association with man, the animals have no sense of that kind: they obey their instincts, they have no sense of right and wrong, no sense of seeing the better and choosing the worse,—which is so characteristic of mankind,—no sense of sin.

How this sense arose, who is to say! It probably arose gradually, like everything else: and yet, dramatically, we may conceive its apprehension by some early genius of the race,

who felt that some things had been forbidden, who knew that he had the power of choice, who realised the meaning of Good and Evil. Such an one might well be called "the first man." Whether we call him Adam or not, matters nothing. In that way began the special privileges and responsibility of humanity. It was an upward step, and he fell over it.

There is no real opposition between the biological account of the rise of man, and the scriptural account of the Fall. One is the natural sequence of the other: they are two aspects of the same thing.—You cannot fall effectually unless you rise. Given the rise, a fall was inevitable. It is possible to graft on this idea much mischievous doctrine: humanity is always making mistakes and spoiling its own outlook. Yet there is a sense in which we do suffer for the faults of our ancestors, just as we inherit their gains and advances. We are standing on the shoulders of those that have gone before us; we reap the fruits of their weaknesses, as well as of their strength.

All these facts can be put in allegorical form; but it is the facts that are important,

not the allegory. The old legend in the third Chapter of Genesis is very crude, but it contains a great truth,—man's disobedience to the higher light within him, and the threatening of a more dreadful kind of death; not the mere death of the body, which is inevitable, and had been from time immemorial, but a death of the soul,—what is called in theological language "a falling away from Grace," a falling below his own level, a failure to seize opportunities that had come within his reach, rejection of the higher and free choice of the lower; the decadence, the deterioration, the sinking back to the brute, after he had attained the standard of man.

It is not for us to judge individuals; and we are not judging, but sorrowfully admitting that historically such dire lapses have occurred. They may occur in nations, in communities, in individuals: and the decadent nations and individuals have gone under. Such lapses may occur temporarily in our own persons. It is not anything outside us which can really damage and destroy us: nothing can ultimately hurt us but our own selves.

Decadence and degeneration do seem possible. Advance is not always upward: there are declensions too. We are free to choose.

Free will is a reality, a fact of experience. Do not be deterred from admitting it by difficulties of interpretation. Never reject a fact on account of imperfect theory. We may not know how freedom is possible, but we know, we feel, that we possess it. We really can choose; the burden of choice has been thrust upon us: and if we persist in choosing wrong, a terrible kind of soul-death may supervene,—whether eternal or not is beyond our knowledge, our enquiry.

Why was this danger permitted? Why was this formidable gift of free will granted? Why were we not made perfect, like machines? The answer is obvious. The production of a race of free creatures who would go right of their own volition, not because they were compelled, but because they willed, not by necessity but by free choice,—the evolution of such a race as that—was evidently of sufficient value to justify the running of the risk. The risk was real. The problem, the idea of constructing

a free being, is far beyond any contrivance or ingenuity of man: he can invent and make machines, he cannot endow any of his manufactures with self-determined spontaneous activity, he cannot give them true responsibility and freedom.

And note that once freedom was granted, it was fully granted. No man or group of men henceforth could be stopped from self-destruction by coercion. Influence, yes. Leading, guiding, educating, helping, all these. But force, no. Henceforth man was to be guided, not impelled. The risk was great; the value of the outcome would be greater. This was the spark of Divinity incorporated in man. Thenceforth he became as gods, knowing good and evil, with the power to help or to hinder the age-long process of evolution; which so far as this earth was concerned was to culminate in him, with the evident ultimate hope that he would become, perhaps ages hence—or, as we hope, even now to some extent—an understander and sympathiser and co-operator in the Divine process of Evolution.

That however is not the end. Free beings

needed help, sympathy, compassion, assistance: they could not be made to receive it, but help could be put within their grasp. Since by man came death,—the terrible risk of soul-death,—by man should come also the resurrection from the dead. For as in Adam all die, even so in Christ shall all be made alive. What is the meaning of that?

Feebly and materially as it has often been interpreted, as if it had reference to mere persistence of existence, it contains the profound truth that the responsibility for creating a race with such nascent faculties and such freedom as man possesses, entailed co-operation and assistance from the Creative Power. And so, as all Christians believe, in various forms and probably with mistaken details, a Lofty Being took flesh and dwelt among us, to share the weaknesses and burdens of humanity, to give us the assistance and influence towards good that we needed—to give us a higher and nobler outlook, to demonstrate the potentialities in human nature, to teach us something of what the heart of the Universe was really like, and so to preserve the race from pitiable doom

and self-extermination. For us men and for our salvation, as it is said, such an one came down from Heaven.

The teachings of orthodoxy about this are over-explicit, and wherever they are over-explicit they are likely to be mistaken. The details are beyond us. We need raise no question of Physiology; nor can we examine the Incarnation in the light of Science. Just as life entered at a certain stage, and mind at another stage, and the consciousness of freedom or the divine spark or soul at yet another, so now the Divine spark was kindled into flame. Some of the attributes of Deity were then made manifest in human form, and a Revelation of the nature of Godhead was permitted to humanity, for its help and encouragement in its too difficult task. Henceforth man could be conscious of a Being anxious to help, when help was asked for, willing to strive and suffer, loving and hoping for love freely rendered in return! No longer need man be overwhelmed by the workings of an inscrutable Power which he could not understand: he could begin to realise that at the centre of all this

majestic Universe lay the heart of a Father, —pitying and long-suffering and of great goodness, kind even to the unthankful and the evil, and only hoping that the free creatures who had been brought into being through long stages of preparation might refrain from rebellion and self-inflicted suffering, might respond to the loving care with which their life was surrounded, and might realise that the Universe was a good and beautiful and kindly as well as a magnificent thing. Yea, surely, there was hope that at long last man would willingly seek communion and enter into a real friendship, now that the nature of Godhead had been revealed. This attainment may be for saints, but any man might henceforth realise that even to him a helping hand was held out, that he was not isolated or unbefriended, that all his efforts would be assisted, that he might ask for what he wanted in the spirit of a child, and that what was good for him would be given, so soon as he was willing to receive it.

Apart from all puzzles of Theology, that is the simple truth. We are immortal beings,

with a great destiny before each individual one of us; and we are surrounded by a host of helpers, with whom indeed I know that it is possible to have communion,—not continually, but at times and seasons. Henceforth we may appeal to our Elder Brother, who once dwelt as we do on the planet, and who is still carrying on his work in a spirit of love and sympathy, with an extraordinary omnipresent power to help.—He did not leave us comfortless, his Spirit came to us, and abides with us, unless in our terrible freedom and self-sufficiency we reject the helping hand. He told us the Kingdom of Heaven was within us. He showed us the heights to which man could rise. —It is suggested that in bodily form he was the earthly Incarnation of a Being existent through all eternity, who has assisted all along in the process of evolution, so that without him was not anything made that was made, and who came to tell us plainly of the Father. On such a complex subject we should not dogmatise: either we feel it in our bones, or we do not. His message was one of singular simplicity; it was free from theological subtleties,

it was understanded of the simple, it was preached by fishermen, it was revealed to babes.

After all, it happened not so long ago: there was much civilisation before that, the great works of the Ancients had already been written. It is, so to speak, the last word in evolution, so far. It shows us what is possible. The evolution of man is far from complete, it is a going-on process, a long-continued process, of which we only see the beginning; but we have had an indication of what man may become, and of the divine elevation which is within his reach.

CONCLUSION

AND now in conclusion let us try and summarise the two main stages in man's evolution. First came the knowledge of good and evil, the sense of sin, the power of judging,—the sense of transgression, the sense of law. Thereafter man was prone to judge not only his own actions but those of his fellows; an era of criticism and self-righteous judgment set in, and continued through some terrible millennia of wrongdoing and backsliding, as narrated in the Old Testament, bringing untold misery in its train. This epoch of law and judgment is by no means extinct even now. In village communities it is represented by an atmosphere of gossip and scandal and backbiting and harsh judgments. In towns it is different, but may be worse. Scandal and implied self-approval are rampant. The pharisee still contemns the publican, the scribes still expose and condemn the sinners. Every fault

is seized upon, relished, and proclaimed abroad, by ninety and nine just persons who appear to need no repentance.

First then the reign of human law and judgment. Then came a strange innovation, a new dispensation, replacing the old code of conduct by a spirit of human kindness, charity, service, and brotherly love. The new rule was "Judge not." "Thy sins be forgiven thee." Not to the righteous but to the sinners, not to the high-minded but to the poor in spirit, not to the prosperous but to the wretched and outcast, came the new message. The Kingdom of Heaven is to be found where it is least expected; it is like a strayed sheep, a lost coin, and again it is like a grain of mustard seed. It is not conspicuous, it has to be sought and tended and nurtured and rejoiced over when found; but it has unlimited possibilities of growth,—the eagles can rest in its branches. It is not concerned with judging and ruling, but with sympathising and forgiving and serving. The rule of the Kingdom is forgiveness as we forgive others. The greatest is to be servant of all. The domination of

law and judgment and self-aggrandisement is over. The only valid judgment is the Last Judgment: no human judgment in the end, but a Divine one. And that leads straight to an ultimate destruction of evil, a winnowing out of the grains of goodness, and a burning of the chaff with unquenchable fire.

Read intelligently, as a whole, the Bible contains an epitome of human history. First the recognition of law, the knowledge of good and evil, not in oneself only but in others. Crime and punishment and cruelty followed. This stage of revenge and retaliation—eye for eye and tooth for tooth—was, we must suppose, inevitable, but it was a sad fall from innocency, and with many modifications it lasted long. Then came a dramatic introduction to, an actual Impersonation of, a higher rule of conduct; emphatically a recognition of the better, a blind eye to the worse, an urge to forgive offences and to live in love and charity with all men. We have not yet progressed very far in this direction, but we are travelling. We may be progressing faster than we think; we do try to help each other; let us not be

despondent. We see the true line of advance, and that is something. The law is not abolished, it is to be fulfilled and superseded by a reign of love. The law was given by Moses, grace and truth came by Jesus Christ.

Do not let the disputes of the churches mar the simplicity of the message in your own mind. It is difficult for man to grasp the Advent fact without decorating it with accretions and human inventions, the survival from primitive times. Yet for all practical purposes the message is simple enough: we have only to follow the light and leading of our Guide, and willingly to obey as he obeyed. "Not my will but Thine be done." "Our wills are ours to make them Thine." That is the only service which is perfect freedom.

The path is sometimes dark and we are far from home, but the way has been illuminated. We know the way. We slip and fall, but we know the right path. We all know it if we are not wilfully blind to the light. We know the Way, and the Truth, and the Life. Help, and all necessary knowledge, have been and will be given. Other feet have trodden the path

before us, we have only to follow. Some indeed are privileged not to follow only but to guide. For on this variously illuminated way we are permitted to act as partial helpers, and so to take our share, our infinitesimal but still needed and asked-for share, in the great and age-long process of The Evolution of Man.

EPILOGUE

THE WORTH OF HUMANITY

THE question has been asked: "What is man that Thou art mindful of him?" In some moods the question is a most natural one; for mankind, not only in its lower grosser forms, but in its commonplace everyday shape, hardly seems worthy of much attention, or of any great sacrifice. To the eye of the cynic it may seem corrupt and altogether abominable. So indeed it has been called by inspired writers. "There is none that doeth good, no not one."

Yet instinctively we know that this is far from being the whole truth, that men have possibilities in them which make them worth saving, and that the assembly of men that we call a nation rightly demands the sacrifice of multitudes of individuals for its sustenance and defence. The struggle of mankind leaves

its mark: the race is bent and contorted like an agricultural labourer warped from the full aspect of humanity by his daily toil, bent and broken in what may be regarded alternatively as the service of others, or as the effort to keep body and soul together; though indeed both body and soul are stunted in the process.

What means this instinct, this determined effort of the animal body to preserve its existence, no matter at what cost of suffering and hardship? Why does the nation call upon her sons to fling themselves into the breach and be mowed down by shot and shell, and why do they willingly respond in spite of tremors of the flesh? Why, again, are volunteers always ready in case of shipwreck, colliery disaster, or fire, to risk their lives and limbs in an effort to save? How nobly people are ready to risk their lives when the call comes. The instinct for sacrifice of this kind is not confined to the higher classes; far from it. It is the property of no class; it penetrates to the lowest who are not degraded. It demonstrates the innate worth and dignity of humanity.

And apart from these more bodily efforts,

we may well ask why the geniuses of the race live laborious days and strive to do their best work, even though they be not recognised in their lifetime, leaving it as a legacy to their successors, in faith that some day it will be appreciated and used. There must be something in it all, something perhaps which no one fully realises, and yet which, if realised, would justify the whole uplift. Clearly it must be in association with something perennial and durable and permanent. No evanescent race, doomed to early futility, could be worthy of all this labour and sorrow. The pain in the world would be too oppressive if we were creatures of a day, or doomed to extinction. A butterfly existence would then seem the most appropriate, joying in the sunshine while it lasts, sipping the honey, and laying up no store for the future. The work in city office, in slum, in mine, would not be sensible or sane. Existence would be too small for any heroic effort or any great personal sacrifice.

Yet we know instinctively that such a contention would be false. We know that our

efforts, our hard work, our sacrifices, are just and right, that they must fit into the scheme of things, that our instincts do not deceive us, and that man as a race must have a value and an innate worth which it is difficult to exaggerate.

One may suspect that this is because of the high altitude attained by some individuals—Plato and Shakespeare and Newton, for instance; and Handel and Beethoven, Leonardo and Michael Angelo, Virgil and Tennyson—that these are the kind of fruits for which the race exists, for which the roots burrow down into the earth, and for which the trunk and limbs bear the storm and stress and frosts of winter. Certainly these are a sign and indication of what the race may become. The height of intelligence attained by some men in the past is majestic. If altitudes like this are possible to humanity, it may be that the average will one day attain them. But even that would not explain, or, at any rate, not exhaust, the value of humanity.

To the eye of religion the value of man is not limited, or even defined, by his individual

achievement. There appears to be something in man, man as himself, which justifies the labour and sacrifice that has gone to produce him. Consider indeed the history of the planet on which man has at last appeared. Its age since it was molten is not accurately known, but is estimated as of the order of four hundred million years—not less than that. That appears to be the record of the rocks. Well, then, for these four hundred million years, for all except the last few hundred thousand, what were the inhabitants of the planet? Vegetation—beautiful, no doubt, and luxuriant—fishes, reptiles, and birds—and ultimately mammals—filled the scene. For ages nothing higher than reptiles crawled about on the surface of the globe. The history of man, compared with the history of these creatures whose remains are buried in the rocks, is ephemeral, and as it were momental. To them the earth seemed to belong. And the object of it all was unknown to any consciousness which had then come into being on the planet. For ages it must have seemed an apparent waste. No

response to the Creater; no understanding or conscious help.

Ultimately, however, after long patience, and through all these millions of years of preparation, a creature with the beginnings of real consciousness, with the sense of free will, and a knowledge of good and evil, and something more than mere sensual enjoyment in his capacity, was brought into being. Presumably by no quicker process could the conditions have been satisfied. A being who could become almost anything by further development; whose will-power was treated as a sacred thing, not to be interfered with; whose actions, whether right or wrong, were determined by himself,—with assistance and guidance doubtless, but without compulsion; a being, therefore, with the ingredients of divinity.

Man became like unto the gods, made in their image, after their likeness; and the seeds of infinite growth and development were planted in him. Free will was granted to humanity; there was no more effort at mechanical perfection. Man became conscious of good and evil, and of his power of choice. He ac-

quired simultaneously Freedom and Responsibility. Henceforth he could help, or he could hinder.

The struggles and failures and errors and sins of humanity were a result—an inevitable result—but henceforth his value was undeniable. There was no saying what he might not become; and this potentiality it was that justified all the storm and stress, and the long labour of preparation, which had been gone through in preparing a dwelling-place for his evolution. This it is which justifies the sacrifice of individual men; this it is which in the Christian faith justifies the sacrifice, the pain and suffering, even of God. The world as it had now come into being was worthy of divine help. Prophets and saints had been sent to help it, and for the most part they had been misunderstood, rejected, and sometimes slain. Yet the world was regarded by Higher Powers with hope and affection, and the sacrifices which had been called for on the part of man were destined to be supplemented by the entry into it of a Divine Spirit. The aim was so high, the prospect so splendid, that pain and

suffering could no longer be limited to man; they must be shared by God. And ultimately God so loved the world that he gave the Being we are taught to call His Only Son, to live on the planet, and to undergo the rejection, the torture, and the death which was in store for a Being higher than the sons of men could understand.

This alone demonstrates that humanity must have an infinite worth and value. In no other way could the sacrifice be justified. There must be an ultimate outcome such as none of us has yet conceived, and yet of which some glimpse has been caught by inspired writers.

In the beginning, we are told, God created the heavens and the earth. In the end—with the assistance of the free beings whom by gradual evolution He has slowly brought into existence—shall He not create, yea, He is already in process of creating, a new Heaven and a new Earth, a brotherhood of man, wherein dwelleth righteousness.

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